Gender Gap and Gendered Education:

Myth or Reality?

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**Abstract**

**Introduction**

Statement of Problem

From the first moments of life each person enters a society that is structured on a binary system of gender (West & Zimmerman, 1987). The first words uttered by a delivering doctor are a declaration of an infant’s gender based on anatomic characteristics. In this type of gendered society each child learns that males and females are different in many aspects from anatomical and cognitive to cultural. These elements are often constructed into socially accepted gender stereotypes (Ridgeway & Correll, 2004). Whether based on scientific facts or socially created concepts, the socially imposed stereotypes can and often do impair our children’s education (Gunderson, Ramirez, Levine, & Beilock, 2012; Ridgeway & Correll, 2004). The problem that this research will be exploring is that socially created stereotypes, such as “math is for boys” or “girls are not good at math,” are unconsciously and habitually reflected in educator’s instructions and affect female students’ attitude and achievement in mathematics. In order to attempt to create a change in the classroom, teachers should implement instructional strategies that will benefit both boys and girls. There are a number of approaches that can be undertaken, from differentiated instruction to single-gender education. This author’s proposal for intervention is to change a learning environment in the classroom that eliminates competition based on gender, boys against girls, and facilitates co-ed, cooperative, and peer learning during mathematics instructions.

In order to attempt to create a change in the classroom, teachers should adjust instructional strategies to minimize bias treatment and reinforce a heterogeneous, peer-learning environment. While this research focuses primarily on gender inequality in mathematics that disadvantages girls, it is worthy of note that boys also find themselves victims in the gendered imbalance in education, primarily in Literacy subjects and discipline (Buchmann, DiPrete, & McDaniel, 2008).

Review of Related Literature

*Math gender gap or no gap: Is there a problem?*

For the past four decades researchers from the fields of psychology, sociology, and education have examined, compared, and quantified the academic achievement of male and female students with a number of conflicting results (Ding, Song, & Richardson, 2006; Kane & Mertz, 2012; You, 2010). Disagreements arose not only about the causes of possible gender gap or at what age such gaps may occur, but also on the very existence of the differences in academic achievement between gendered student population (Gool et al., 2006; Ding et al., 2006; Marks, 2008; You, 2010). As persistent and widespread as the belief in gender stereotype regarding mathematics is in our society, such as “math is for boys” and “girls are not good at math,” one can reasonably assume that it is reflected in our children’s academics success and achievement. Ding et al. (2006) cite findings from the 1980s that show a strong male advantage in the mathematics where boys scored above 600 on the math portion of Scholastic Aptitude Test (SAT) 4 times more often than girls. Dr. Jean Atkin Gool (2006) and colleagues examined works by a number of researchers and cite results based on 2004 Advanced Placement tests for science and mathematics, showing boys leading anywhere from 0.27 to 0.47 points (on a 5.00 grading scale) in calculus, computer science, biology and physics. Nosek, Banaji, and Greenwald (2002) provide the data from National Science Foundation (NSF) that displays an existing gap of 41 points favoring male students among the SAT mathematics section. With results like this and powerful gender stereotype, it appear that the popular cultural belief of women (girls) being worse at math than men (boys) holds true and continues to function as a self-fulfilling prophesy for future generations. The existence of gender gap is just one tool to justify gender stratification in educational and workforce organizations. If the belief of math-gender stereotype is strong in the hiring manager, he or she is more likely to give a math-intensive job to a male applicant than an equally competent and qualified female.

On the other hand, in spite of popular belief that girls do not do as well as boy in mathematics, a number of researchers (Ding et al., 2006; Gunderson et al., 2012; Nosek et al., 2002) found the gender gap to be very minimal or not to exist all. Their studies and overviews agree that gender gap in academic achievement has diminished over the past couple of decades. Ding and colleagues (2006) report the findings of their own study, which display a very minimal difference among male and female middle school students’ mathematic achievement, favoring male students. In their second study the high school student sample displayed results contrary to the math gender stereotype where female students scored higher than male students. School of Science and Mathematics posted a “Research in Brief” review that shows a number of studies that produce similar results and identify the disparity in male and female student test results as statistically insignificant (You, 2010).

To further display the conflicting research findings, Geist and King (2008) claim that data from the National Assessment of Education Progress (NAEP) shows a gap of 2 points between genders and that this gap has developed only in the last decade. They go further to support this claim by citing prior research that displayed girls outperforming boys in 1970s. This prompts a look at discrepancies about timing of these possible or nonexistent gender gaps. In other words, determining at what stage in educational careers gender gaps are displayed. Ding et al. (2006) present extensive literature overview that shows continued inconsistencies among researchers from 1981 to 2002 on the time of development of gender differences in children’s academic careers. In their review of scholarships, Ding and colleagues cite several studies that report female students outperforming male students in earlier grades but by middle school and high school the math achievement results favor males. They cite other researchers who provide polar opposite conclusions where girls being their academics with lower math scores but then have equal or advanced results over their male counterparts in higher grades. Another research by Abigail Norfleet James (2007) uses data from NAEP to show a very small gender gap in mathematics in 2004, however upon a more detailed review discovers that while on basic level math boys and girls show the same levels of proficiency, in more advanced or complex areas girls’ scores noticeably drop.

These disagreements among various studies lead to a question. Why do cultural beliefs and stereotypes regarding gender and mathematics still persist today if there is no conclusive data to support them being factually true? The answer lies partially in the gendered society and how cultural beliefs structure social understandings of binary system of gender and established stratification. Perception of women being as competent or more competent in mathematics as men does not fit the cultural belief system that maintains patriarchal hierarchy. “Men are viewed as more status worthy and competent overall and more competent at the things that “count most” (e.g., instrumental rationality). Women are seen as less competent in general but “nicer” and better at communal tasks…” (Ridgeway & Correll 2004, p.513). Since mathematics is a required skill for many high-valued and demanding jobs, these positions in STEM fields are more readily attributed with men. These hegemonic cultural believes lead to a conclusion that women are bad at math in opposition to men who are good at it, thus reinforcing social relational contexts theory (Ridgway & Correll, 2004).

*Gendered attitudes toward mathematics: Students’ implicit math-gender stereotypes.*

While there is a debate regarding the existence of academic achievement inequality based upon gender, another type of inequality is indisputable. Whether there is a gender gap favoring male students or women generally perform as equally or better than men, one fact remains true: women are underrepresented in the STEM field jobs. Although there have been many strides toward improvement in gender equality in the job market over the past decades, “among the recent doctoral degrees awared in the U.S., women accounted for 27% of women in mathematics, 15% in physics, 20% in computer science, and 18% in engineering” (Leaper, Farkas, & Brown, 2012, p.268). Fewer women than men pursue STEM careers and fewer female students than male students enroll in advanced elective mathematics courses in college and high schools (Brandell & Staberg 2008; Leaper et al., 2012; Steffens, Jelenec, & Noack, 2010). Campbell, Verna and O’Connor-Petruso (2004) use data from year 2002 to demonstrate the gender gap in representation at the Academic Olympiads. In the United States the ratio of male to female Academic Olympians was 44:1 in mathematics.

The reason behind this lack of participation in mathematics is connected to socially constructed stereotypes affecting girls’ and women’s attitudes, motivation and belief in their own performances in mathematics. Several studies showed that children accept and employ the socially constructed stereotype that portrays mathematics as male-oriented subject and skill (Leaper et al., 2012; Nosek et al., 2002; Steffens et al., 2010; Stetsenko, Little, Gordeeva, Grasshoff, & Oettingen 2000).

By associating math with ‘male’, and themselves with female, girls “appear to reflect a free and individually determined choice when in fact they reflect group membership, the strength of identity with the group and beliefs about the capability of the group” (Nosek et al., 2012, p.44). Adhering to socially constructed math stereotypes females consciously or unconsciously choose their behavior based on their gender identity and what is socially appropriate or accepted for that group by comparing and positioning themselves in opposition to men and their behavior (Risman, 2004).

Nosek and colleagues (2002) describe the process of gendered female logic perfectly in their article title “Math = Male, Me = Female, Therefore Math ≠ Me”. This holds true and is supported by the results from their studies of college students expressing their opinions about mathematics. In their research, both men and women have strong identifications with their own gender. Both men and women displayed strong beliefs that math = male. Both groups were asked to express their opinions about mathematics in comparison to other subjects such as art, language, and science. As expected, women had increasingly higher levels of negative attitude toward mathematics than men. Such math attitude differences were also true with men and women with strong math-related majors. This displays that when measuring mathematics against another subject, women lean more toward the socially acceptable “feminine” options. Even women who are pursuing math-related fields express greater negative attitudes toward mathematics than men and thus in part reinforcing the cultural belief system (Nosek et al., 2002).

Steffens and her colleagues (2010) examine similar research conducted with adults and apply it to children to study when gender stereotypes begin to affect students’ competence and attitudes. Using a sample group of children in Germany from 4th, 7th and 9th grades, the researchers focused on detecting implicit stereotypes and attitudes toward mathematics vs. German language. The results showed that children as young as 4th grade exhibit implicit math-gender stereotypes and have negative attitudes toward mathematics. An international research examined students’ gendered differences in students’ beliefs about their own abilities in school performance. The findings showed that boys and girls rated themselves realistically in accordance with their performances. The most interesting data came from the girls who outperformed boys in certain subjects, yet they still rated their performance equal to that of boys and not higher. They also ascribed their high performances to luck or hard work rather than talent (Steffens et al., 2010; Stetsenko et al., 2000).

*Nature vs. nurture: causes of gender inequality in education.*

Regardless of whether there is an actual quantitative gender gap in academic achievement in mathematics or qualitative math attitude differences between boys and girls, there has to be a reasonable explanation as to the cause or multiple causes of the gross underrepresentation of women in STEM fields.

The social structure of gender dictates that men and women are different and oppositional (Ridgeway & Correll, 2004; Risman, 2004; West & Zimmerman, 1987). Educational cultural stereotypes and some research results adhere to this model with boys’ achievement being associated with mathematics and girls’ with language (You, 2010). There are a number of theories and hypotheses as to what factors contribute to such differences ranging from biological to social (Campbell et al., 2004; Ding et al., 2006; Kane & Mertz, 2012). This section will outline a few of most prevalent hypothesis.

The first element of difference between a man and a woman has always been identified with biological or physical markers. Differences in physique have been attributed to various abilities or lack there of and have long settled into our social perception (e.g. “woman = weaker sex”). When it comes to explaining why males supposedly tend to excel in mathematics over women, researchers, mostly psychologists, proposed biological or cognitive differences as a valid explanation. To generalize, biological hypotheses propose that men are better at mathematics due to their genetic predisposition to various cognitive activities that assist in math problem solving, and, by default, women lack or have lesser of those natural abilities. As an example, Campbell, and colleagues (2004) cite a number of researchers claiming that the innate predisposition to mathematic success lies in specific genes on the X and Y-chromosomes. Zhixia You (2010) cites a number of researchers who propose that the differences were due to biological differences in girls’ and boys’ brains as perceived by the observation that “girls are in general better with language and writing, and boys are better at math due to better spatial abilities” (p.115).

Geary, Saults, Liu, and Hoard (2000) propose that males hold an advantage in arithmetical reasoning due to their innate special cognition ability and computational fluency. They define arithmetical reasoning as the ability to solve complex world problems. Their research findings concluded that there is a possible advantage that males have due to better cognitive abilities.

James (2007) suggests that biological differences include hearing and vision differences among a few others. Due to women’s high verbal skills they prefer to learn by hearing the processes and explanations, where’s men prefer to read them. On the other side, men are supposedly drawn to moving objects and different colors so the instructional strategies should incorporate motion and displays. A research that encompassed a number of other countries produced a wide variety of results in different countries rendering solely biological theory invalid (Kane & Mertz, 2012). The hypotheses about biological factors benefiting mathematical intelligence and achievement all have one underlining factor of unavoidability. If biological or genetic factors affect our achievements that would mean that it could not be changed or altered. Taking into the account that there have been changes in gender gap and mathematical achievement between both genders over the past few decades, while no evolutionary changes to the human genetics have been reported, the biological hypotheses seem very unlikely (Ding et al., 2006). If the biological theories were correct, the differences between male and female students would be similar across all participating countries (Kane and Mertz, 2012).

On the other side of the spectrum are the socialization theories. The theories propose that the differences between male and female achievement in mathematics is the different way the two genders are socialized in our society (Cvencek, Meltzoff, & Greenwald, 2011; Ding et al., 2006; Gool et al., 2006; Nosek et al., 2012; You 2010). The socializing element encompasses the effect that society and cultural beliefs have on the child as well as ways that adult and peers influence child’s decision and belief system. From birth, children are socialized differently; boys and girls are taught to behave in a way that is socially acceptable for the appropriate gender. “Boys are taught at a young age to be leaders, competitive, self-sufficient, independent and willing to take risks” while “society asks our young girls to be affectionate, cheerful, loyal, understanding, and sensitive to the needs of others” (Gool et al., 2006 p27). These are just a few of cultural beliefs that define male and female natures within the complexities of gendered social structure.

As children grow up and establish their gender identify they begin to function in the social relational context, constructing their behaviors and, therefore, their gender in relation to others, both male and female (Ridgeway and Correll, 2004). Society (media and social groups) and individual adults in every child’s life affects their perception of what is acceptable in the social gender arena. The way gender as social structure functions on the interactional level, parents, teachers and peers play a key role in shaping a child’s beliefs about society and him or herself (Risman, 2004). Eccles, Jacobs and Harold (1990) review a few longitudinal studies as well as their own previous work to find supporting data that shows how parents’ support of gendered bias and stereotypes influence their children’s perceptions of their own achievements. “If parents hold gender-differentiated perceptions of, and expectations for, their children’s competencies in various areas, then, through self-fulfilling prophecies, parents could play a critical role in socializing gender differences in children’s self-perceptions, interests, and skill acquisition” (Eccles, et al., 1990). Through exposure, games, and inexplicit remarks parents can transmit to their child their high or low expectations and personal beliefs in their child’s mathematic abilities.

In a more recent article, Gunderson et al. (2012) examine how teachers and parents affect the development of children’s gender-related math attitudes. In their review, they “conceptualize math attitudes as a cluster of beliefs and affective orientations related to mathematics, such as math anxiety, math-gender stereotypes, math self-concepts, and attributions and expectations for success and failure in math” (Gunderson et al., 2012, p.152). They present various studies that support their assessment of parents’ ability to explicitly and inexplicitly transfer their gender math stereotypes and cognitive bias onto their children by showing more or less support and encouragement, which then affects the child’s perception of their own math abilities. “Notably, parents’ beliefs about their children’s math ability predict children’s self-perceptions in math even more strongly than children’s own past math achievement; further, children’s self-perceptions about math affect their subsequent math achievement” (Gunderson et al., 2012, p.155).

The review also examines how teachers’ gender bias and personal math anxiety can affect their students’ self-perception of mathematics. The authors cite various studies that show teachers’ beliefs that boys are better and more interested in mathematics than equally competent girls. They also outline how teachers can express their own math biases and anxieties through rushed or biased instruction or unequal allocation of attention among different gender students (Gunderson et al., 2012).

In an earlier study Beilock, Gunderson, Ramirez and Levine (2010) presented their findings of how female teachers’ math anxiety affected girls but not boys in the classroom. The study conducted involved several classrooms and female teachers with various levels of math anxiety. Researchers examined the students’ math achievements in the beginning of the school year and compared them to those at the end of school yet. The results showed a significant relation between female teachers’ anxiety levels and girls’ math achievement at the end of the year. This reflects their hypothesis that when it comes to gender, children are greatly affected by adults of the same gender who serve as primary role models and shape girls’ attitudes toward mathematics (Beilock et al., 2010).

To follow the socially imposed stereotypes, students can also underplay their competencies to fit in with the gendered group. As a result, even though gifted children of both genders would be encouraged to develop their abilities at earlier ages, “during early adolescence and adulthood many gifted females learn to camouflage their talents in an effort to gain acceptances by other females” (Campbell et al., 2004, para.10).

In between the polar opposite theories, biological and socialization lies a hypothesis proposed by Robert Plomin that presents an even divide between nature and nurture elements that effect children’s achievements in academics (Campbell et al., 2004). Plomin, a psychologist and genetic behaviorist, conducted various studies with twins, which suggest that the cause of gender differences in academics stems from both genetic and diverse socialization (Pearce, 2003; Spinath, Spinath, & Plomin, 2008). The studies showed that even similarly raised and cultured twins have grown up with academic and motivational difference. The researchers thus concluded that elements that account for those differences must be genetic inheritance of each twin (Spinath et al., 2008).

*Stereotype Threat Theory.*

In addition to presumably being biological, sociological or both, gender inequities in education have a strong psychological element. As people function with a binary gendered society, they form their behavior based on situations they find themselves in as well as social expectations (Ridgeway & Correll, 2004). Occasionally, these expectations are shaped by biased stereotypes and have an effect on a person’s behavior and others’ perception or evaluation of said person. According to research, stereotypes or hegemonic cultural beliefs play a strong role in females’ lack of performance regardless of their true skills or abilities (Moe, 2012; Ridgeway & Correll, 2004; Shapiro & Williams, 2012; Spencer, Steele, & Quinn, 1999; Tomasetto, Alparone, & Cadinu, 2011).

Stereotype threat theory first emerged in 1995 through research that studied performances of African Americans students on standardized tests compared to their white classmates. The authors, Steele and Aronson, found that African American students who were made aware of the test functioning as a comparison between students of different race, performed worse as opposed to their classmates who were told it is a simple test to examine their mathematics skills. (Schmader, Johns, & Forbes, 2008). Based on the developed theory “stereotype threat” refers to the concern of being in a situation where one’s performance might lead to be judged based on social stereotype. In other words, a person experiences heightened levels of pressure and anxiety that his or her actions will confirm a negative stereotype as evaluated or judged by others (Shapiro & Williams, 2012; Spencer et al., 1999).

Much like the aforementioned example, women suffer from the stereotype threat based on the cultural beliefs that women are not good at math. “This experience begins with the fact that most devaluing group stereotypes are widely known throughout a society (Spencer et al., 1999). Several studies observed young children, adolescents and adult women confirming that women underperform when introduced to stereotype threat situations (Moe, 2012; Shapiro & Williams, 2012; Spencer et al., 1999; Tomasetto et al., 2011). When presented with a math skills test, male and female subjects showed very similar results until a group was introduced to stereotype threat condition. Participants were informed that similar test produced gender differentiated results and that men performed better than women or were proved to be genetically better at math. Women who were made aware of such stereotype threat performed noticeably worse on the same test, compared to women who’s gender was not made salient (Spencer et al., 1999). While prior research was conducted with adult participants in the study with adolescents, stereotype threat was introduced on a less direct level by making teenage students identify their gender before or after the math test. Female students, who identified their gender before the test, performed 33% worse than students who identified their gender after the exam (Shapiro & Williams, 2012).

Tomasetto and colleagues (2011) took a step further and conducted a similar research with younger students (5-7 years of age) and observed how parental gender stereotype attitude affected children’s achievement in mathematics. In their results, these researchers observed female students in the stereotype control group, for whom gender identity was made salient, performed lower on math tasks. They further note that “performance disruption was found even for girls in lower elementary grades who did not endorse – and probably did not even know – the traditional gender stereotype about math, at least at an explicit level” (Tomasetto et al., 2011, p.947). Therefore, their conclusion is that stereotypes are present in girls’ environment on the implicit level and makes them vulnerable to stereotype threat. Further examination of parental stereotype attitude concluded that mother’s (but not father’s) endorsement of the stereotype threat increased the chances of the female student to be effected by the stereotype threat. The authors finally conclude that the performances of those students whose mothers’ rejected math-gender stereotypes did not suffer as a result of a stereotype threat (Tomasetto et al., 2011).

*Segregated or Together: Proposed Solutions for Gender Inequality in Education*

Gender appears to be a simple binary system that everyone uses, but in reality it is a complex system that affects people’s everyday life, their behavior, choices and performances (Ridgeway & Correll, 2004). The gender system as a social structure creates inequalities in various areas of life, such as jobs, education, private and social settings. It is so ingrained into every individual as they function within the society that completely eliminating the gender-based cultural belief system seems like an impossibility. However, though the past decades, the changes to lessen gender inequality on the institutional and legal levels have been substantial (Ridgeway & Correll, 2004). Barbara Risman (2004) proposes that by institutionalizing children differently a society can take first steps in the direction of recognizing sexism and figuring out a way to battle it. When it comes to gender inequality in education, educators and researchers alike have proposed various methods to provide students with equal education and opportunities as well as lessen their gendered perception of mathematics. These solutions range from lowering students’ anxiety and raising confidence to instructional and institutional changes.

As Risman (2004) has pointed out, the first step is recognizing the problem. Since teachers are one of the stronger influences on children’s attitudes toward math and belief in their achievement, educators need to become aware of any existing biased practices that occur in their classrooms. Tracy and Lane (1999) propose and study the implementation of Gender-Equitable Teaching Behaviors (GETB). By keeping a detailed record of her or his actions within the classroom, such as praise, criticism, high level of questions, acceptance, wait time and physical closeness, toward every student, a teacher can evaluate their behavior and spot any gender-biased behavior. By recognizing an issue, a teacher will be able to adjust as needed to create a more gender-balanced environment (Tracy & Lane, 1999).

While Tracy & Lane (1999) suggest a more equal treatment of students, Geist and King (2008), as well as James (2007), propose a differentiated approach to teacher’s instruction. They believe in cognitive differences between gendered and therefore offer solutions for boys and girls who learn differently. James (2007) offers a number of strategies that will encompass the differences between male and female students’ needs, such as auditory and visual learning. She also implies that women gather information from body movement and facial expression of the instructor, while men avoid looking or being looked at while they work. She further proposes, and is corroborated by Geist and King (2008), that girls, who are highly verbal, will benefit from hearing detailed explanations and comments on all steps and procedures. Boys, on the other hand, are very visual and therefore will need colorful and moving imagery to accompany instruction. When differentiating, the most difficult task is developing instruction that encompasses a variety of learning levels, abilities and styles in the classrooms (Geist & King, 2008).

Taking a differentiation approach a step further, Herrelko, Jeffries and Robertson (2009) present a study that illustrates a school’s attempt at improving mathematic achievement by segregating its students into single gender classrooms. A failing school reformed its’ classrooms to fully segregate its students by gender. The results of this change showed grade improvements in younger grades but a decline in 6th grade. The authors’ subjects reported less disruptive behavior in classroom in earlier grades but higher level of misbehavior in 5th and 6th grades. These results imply that single gender classrooms may benefit younger students who do not specifically seek interactions with the opposite gender in a social setting while older students who enter the social arena do not welcome segregation (Herrelko et al., 2009). The single-sex classrooms approach is supported by Gurian, Stevens and Daniels (2009), who are strong proponents of the theory of cognitive gender differences. They claim that such practices allow instructress to create classrooms that are “more boy- and girl-friendly” (Gurian et al., 2009, p.235). The article offers a number of success stories from schools in several central and southwestern states, testimonials from teachers but none from students themselves.

As described earlier, not everyone shares this enthusiasm about single-sex education. American Civil Liberties Union (ACLU) strongly opposes sex segregation; filing several law suits against a number of states to investigate unlawful gender differentiation (“Sex-segregated schools”, 2009). Based on ACLU complaints single-sex classrooms offer unequal education to boys and girls. They claim that boys are being taught to be competitive while girls are treated in passive, quiet environments. Boys and girls are explicitly taught gender stereotype “boys are better than girls at math because boys’ bodies receive daily surges of testosterone, whereas girls don’t understand mathematical theory very well except for a few days a month when their estrogen is surging” (“Sex-segregated schools”, 2009, para. 2). The ACLU firmly believes that single-sex education is unconstitutional, based on stereotypes, and does not prepare children for coeducational real world (“Sex-segregated schools”, 2009).

The creation of single gender classrooms, while potentially beneficial, further reinforces the implication of male – female differences. In the opposition to the above solution, several researchers present benefits of co-educational approach. Cooperative learning, peer tutoring and peer assisted learning strategies (PALS) have been researched in a variety of settings to help students with disabilities, learners with behavioral problems, or just to enhance children’s mathematical development (Kroeger & Kouche, 2006; Kuntz, McLaughlin, & Howard, 2001; Tournaki & Criscitiello, 2003). While these studies do not specifically deal with gender differences, they can be applied to gender-inequality situation and benefit students of both genders in a variety of ways.

All of these strategies involve pairing a high achieving student with a low achieving student, or a student with disabilities for a cooperative study sessions. During the session, the students work together to learn and practice a new lesson based on the developed study guide. The significance of these strategies lies in the detrimental co-teaching element. Instead of only having a high achieving student be the tutor and low achieving student being the learner, the roles are frequently switched where each student acquires the responsibility of being the tutor (Kuntz et al., 2001; Kroeger & Kouche, 2006; Tournaki & Criscitiello, 2003). There are several benefits with this approach for both the teacher and the student. From the teacher’s side, “the class-wide peer-tutoring approach permitted teachers to address a challenging mathematics curriculum and simultaneously attend to a wide diversity of math skills in the classroom” (Kroeger & Kouche, 2006, p.6). Kroeger & Kouche (2006) present evidence in their report that students felt they were in a low-stress environment, were fully engaged during peer-assisted learning sessions, and were urged to practice social skills. The ability for the low learners or students with disabilities to be the tutor gives them confidence and support from their peers to share their thoughts. “The role-reversal peer tutoring gives students with emotional and behavioral disorders some responsibility – perhaps for the first time – and involves them in an activity that makes them proud and thus eliminates the need for extrinsic motivators” (Tournaki & Criscitello, 2003, p.23).

The success of these peer-assisted programs can be applied to gender differentiated classrooms. If boys and girls do learn differently, they can both benefit from each other’s point of view and support each other (Sparks, 2012). Instead of the competition, girls vs. boys, there will be a cooperative learning atmosphere, where both genders can learn from each other and gain knowledge equally. In addition, the co-educational activities have social benefits for young children. Sarah Sparks (2012) explains that children of different genders tend to socialize separately as they are being socialized into differentiating between genders. By working together in mixed-gender groups or pairs, students learn social skills and tolerance. Sparks points out, however, “classroom demographics and teacher practices can make a big differences in how and whether students develop sex-based stereotypes and prejudices” (Sparks, 2012, p.15).

While the solution for gender inequality in the classrooms listed above present a good stepping-stone in proving an equal education to both genders. To further address the issues of why female students underperform in mathematics, Shapiro and Williams (2012) offer several stereotype interventions. One of the interventions is a self-affirmation, which is a process of creating positive thoughts about one’s importance or value that is different than the negative threatening situation. Concentrating on a positive thought of value, unrelated to mathematical tasks, elevates the stress of stereotype threat. Another intervention proposed in the article is intended in reducing the differences between the two opposing sides. As an example, women can examine how they are similar with men, instead of concentrating on differences, prior to the test. This strategy has shown to improve women’s achievements significantly (Shapiro and Williams, 2012).

Lastly, the importance of role models is indisputable. Gool et al. (propose that students read about female scientists and mathematicians as well as other women that achieved success in STEM fields. They also suggest that schools invite such influential women as guests to encourage students to pursue these careers. “That is, seeing another individual who was similar to themselves and who disconfirmed the stereotype about female math ability” may provide female students confidence in themselves and serve as a buffer for stereotype threat (Shapiro & Williams, 2012, p.178).

“Although inequality persists, recent decades have brought significant improvement in women’s position in the public sphere, as reflected in indices such as the wage gap between men and women and women’s representation in high-status occupations (Ridgeway & Correll, 2004, p.527). Despite these strides, instructors and policy makers need to continue to ensure that girls receive the same education as the boys. While policies are easier to put in place to enact change, personal perceptions and decades-long cultural beliefs are the hardest to deconstruct. The society needs to socialize and educate children about gender and inequality in order to raise a new generation that can move in the direction of egalitarianism (Risman, 2004).

Statements of the Hypotheses

By creating teams of two (1 boy and 1 girl) during mathematics instruction for the duration of the whole day, three times a week, for the period of 6 weeks, in a classroom of 12 students (6 girls and 6 boys) in an elementary school of Brooklyn, NY, will improve girls’ attitudes toward mathematics.

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**Method**

Participants

Participating in the study are a small group of 2nd grade students, 6 boys and 6 girls, with an average age of 7 years old who attend elementary school X in Brooklyn, New York. Classroom teacher will also participate in the study as an administrator of cooperative educational instruction.

Instruments

* Initial mathematics exam
* Initial questionnaire
* Cooperative pair-activity lesson plans
  + Instructions
  + Manipulatives
  + Exercise
* End-of-study mathematics exam
* End-of-study questionnaire

Experimental Design

Procedure

**Results**

**Discussion**

**Implications**

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**Appendix A: Parental Consent Form**

Dear Parent/Guardian,

I am currently a student at Brooklyn College in the process of completing a Childhood Education Masters Program. As part of our curriculum, I am conducting an action research to determine possible beneficial effects of peer-assisted and co-educational learning instructional strategies on achievement in and attitude toward mathematics among boys and girls. Therefore, I am requesting your permission to have your child participate in the implementation of aforementioned instructional strategies and to use your child’s data that is relative to the research.

All instruction will be administered during your child’s regular classroom time, following the scheduled curriculum objectives. Students will be given a mathematics test and a survey before and after implementation of the new instructional strategies. Data collected from these sources will be reported as group findings; therefore, all participants’ names and other information will remain anonymous. Additionally, at the end of the research I will gladly provide final results upon request.

If you have any additional questions or concerns please feel free to contact me by email [vedmochka81@gmail.com](mailto:vedmochka81@gmail.com)

Thank you in advance for your support!

Sincerely,

Tatyana Sumner

I agree to my child, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, participating in

(student’s name)

the action research described above.

I do NOT agree to my child, ­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, participating in

(student’s name)

the action research descried above.

Signature of Parent/Guardian \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_

**Appendix B: Principal’s Consent Form**

Dear Principal,

I am currently a student at Brooklyn College in the process of completing a Childhood Education Masters Program. As part of our curriculum, I am conducting an action research to determine possible beneficial effects of peer-assisted and co-educational learning instructional strategies on achievement in and attitude toward mathematics among boys and girls. Therefore, I am requesting your permission to use one fourth-grade classroom in your school to implement the aforementioned instructional for the duration of the research.

All instruction will be administered during regular classroom time, following the scheduled curriculum objectives. Modified instruction will take place 3 times a week for the period of 6 weeks. Students will be given a mathematics test and a survey before and after implementation of the new instructional strategies. Data collected from these sources will be reported as group findings; therefore, all participants’ names and other information will remain anonymous. Additionally, at the end of the research I will gladly provide final results upon request.

If you have any additional questions or concerns please feel free to contact me by email [vedmochka81@gmail.com](mailto:vedmochka81@gmail.com)

Thank you in advance for your support!

Sincerely,

Tatyana Sumner

I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, give permission to Tatyana Sumner to use one (1) fourth-grade classroom for the action research as described above.

Signature of Principal \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Appendix C: Teacher’s Consent form**

Dear Teacher,

I am currently a student at Brooklyn College in the process of completing a Childhood Education Masters Program. As part of our curriculum, I am conducting an action research to determine possible beneficial effects of peer-assisted and co-educational learning instructional strategies on achievement in and attitude toward mathematics among boys and girls. Therefore, I am requesting your participation and cooperation to implement the aforementioned instructional strategies in your classroom for the duration of the research.

All instruction will be administered during regular classroom time, following the scheduled curriculum objectives. Modified instruction will take place 3 times a week for the period of 7 weeks. Students will be given a mathematics test and a survey before and after implementation of the new instructional strategies. Data collected from these sources will be reported as group findings; therefore, all participants’ names and other information will remain anonymous. Additionally, at the end of the research I will gladly provide final results upon request.

If you have any additional questions or concerns please feel free to contact me by email [vedmochka81@gmail.com](mailto:vedmochka81@gmail.com)

Thank you in advance for your support!

Sincerely,

Tatyana Sumner

I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, agree to participate in the action research as described above.

Signature of Teacher \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Appendix D: Initial and End-of-Study Math Test**

**Appendix E: Initial and End-of-Study Questionaire**

**Appendix F: Results Tables**

**Appendix G: Results Charts**